The International Journal Of Engineering And Science (IJES)
|| Volume || 5 || Issue || 2 || Pages || PP -01-10 || 2016 ||
ISSN (e): 2319 – 1813 ISSN (p): 2319 – 1805

Study of abnormally-high pore pressure prediction methods in regions with non-equilibrium compaction – Insight of Niger Delta fields.

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ABSTRACT

The aim of this research is to analyze the techniques for the prediction and estimation of pore pressures that have been used for many years and recent method (F.Nweke and A. Dosunmu's method) in the Niger Delta region, focusing on prediction of abnormally-high pressure in Niger Delta regions with non-equilibrium compaction. The describe methods are divided into two groups: methods used before drilling and methods used during drilling. The first group includes: methods for the prediction of abnormally-high pressure using geological and geophysical data in regions with non-equilibrium compaction; methods for the prediction of abnormally-high and abnormally-low pressures in regions with uplift and erosion, or subsidence, of compacted sedimentary rocks; methods for the prediction of low pressure in regions with permafrost; and methods of seismic exploration. The methods belonging to the second group basically involve the use of well-logging and drilling data: the method of equivalent depth, the method of normal compaction trend, and the method of compressional curves.

Keywords *- Drilling data, Abnormal pore pressure, Niger Delta, Pore Pressure Predictions methods, Well Logs,*

Date of Submission: 13 January 2016 Date of Accepted: 05 February 2016

I. INTRODUCTION

The present-day estimations of pore pressure in the shale seals (caprocks) and the development pressure in related store rocks in districts with non-harmony compaction relies on upon the penetrability of seals, the lithology of the geologic segment, the rate of sedimentation (basically amid Pliocene-Quatemary time), and tectonic developments of the world's covering. Basically all pore-pressure techniques used in the Niger Delta region must be adjusted; this is done exactly by and large. Ordinary methodologies depend on drilling knowledge to give adjustment focuses. These adjustment focuses are construct either with respect to the event of kicks, in which case the pore pressure in the sand delivering the kick must be higher than the identical mud weight and lower than the kill mud weight, or on perceptions of hazards in shales. In the previous case, it is accepted that the pore pressure in shales and the nearby sands are the same. In the last case, the suspicion is that insecurities happen when the mud weight has fallen beneath the pore weight. Truth be told, wellbore dangers that are because of compressive breakouts can happen at weights that are higher or lower than the pore pressures. Subsequently, the presumption that crumple starts to happen at a mud weight equivalent to the pore pressure can come about either in an overestimate or a think little of Pp. On the off chance that neither happens, Pp is accepted (once in a while mistakenly) to be not exactly mud weight (Pmud). A further entanglement is that these strategies require that the formation complies with a solitary, monotonic, compaction-incited pattern, and that no different impacts are working. In all actuality, dynamic synthetic procedures can expand cementation, prompting expanded solidness (higher speeds), which can cover high pore pressure, and expanded imperviousness to further compaction, which can prompt wrong forecast of the onset of pore pressure. High temperatures lead to a change of the overwhelming shale mineral. For instance, an expansion in temperature changes a water-bearing smectite to a moderately sans water (and more thick) illite. This change happens over a scope of temperatures close to 110°C, yet they can differ with liquid science; moreover, the profundity at which this temperature is surpassed shifts from bowl to bowl. Pore liquid properties can likewise significantly affect pore-weight forecasts. This is on account of resistivity and speed are both influenced by the sort and properties of the pore liquid. Changes in the saltiness of brackish waters will change resistivity, since pore liquid conductivity increments with saltiness; subsequently a saltiness increment (for instance, neighboring or underneath a salt arch) could be misjudged as an expansion in pore pressure. Liquid conductivity is additionally an element of temperature.

Substitution of hydrocarbons for saline solution will build resistivity, since hydrocarbons don't direct power; this can cover expansions in pore weight that frequently go with the vicinity of hydrocarbons. Since hydrocarbons are more agreeable and less thick than salt waters, pressure wave speed will diminish and shear-wave speed will increment as hydrocarbon immersion increments. High gas immersion or API record will open up this influence. Since a change from water to hydrocarbon influences resistivity and compressional speed in inverse ways, synchronous pore-weight examinations utilizing both estimations can here and there distinguish such zones. It is harder to recognize and manage changes in liquid saltiness.

Most shale properties are, luckily, portrayed by genuinely straightforward and single-esteemed elements of viable anxiety while on the compaction pattern. At the point when de-watering happens and the material gets to be over compacted, they don't take after the same relationship. This is on account of when the compelling anxiety diminishes, porosity and different properties are less delicate to powerful push. Luckily, connections between porosity (or density) and different properties are diverse for over compacted residue than they are for the same dregs when it is ordinarily compacted or under compacted, as appeared in research facility information. This gives an approach to separate in the middle of under compacted and over compacted shales. Once the areas have been isolated, autonomous adjustments can be utilized to decide the pore pressure.

In profoundly lithified, more established silt, as on account of over compacted dregs, it is exceptionally hard to utilize pattern line investigations to decide pore weight. This is on the grounds that, in these residue, the affectability of porosity to successful anxiety is little. Indeed, even in such cases, on the other hand, it is some of the time conceivable (with exact models got from research center estimations and adjusted against in-situ direct estimations) to use resistivity or speed estimations to gauge pore pressure.

II. GEOLOGIC SETTING OF NIGER DELTA REGION

The Niger Delta is a province located in the southern part of Nigeria, Cameroon, and Equatorial Guinea growing into the Atlantic Ocean in a South Westerly direction. It is a sedimentary basin with over one thousand five hundred (1500) fields in the Sub-Sahara region of Africa and has regressive clastic sequence of between 10-12km thickness (Etu-Efeotor, 1990). It covers approximately 300,000km^2, (Kulke, 1995), a sediment volume of 500,000 km^3 (Hospers 1965).

According to (Etu-Efeotor, 1990), the Niger Delta is a prograding depositional complex within the genozoic formation of Southern Nigeria. It reaches out from the Calabar flanks and the Abakaliki trough in Eastern Nigeria to the Benin Flank in the West and opens to the Atlantic Ocean in the South. The Delta juts into the Gulf of Guinea as an augmentation from the Benue trough and Anambra Basin territories. The Delta complex consolidations westwards over the Okitipupa high into the Dahomey embayment. To the South Southeast, the important lines of volcanic rocks are the Cameroon volcanic zones (mountains) and Guinea ridge.

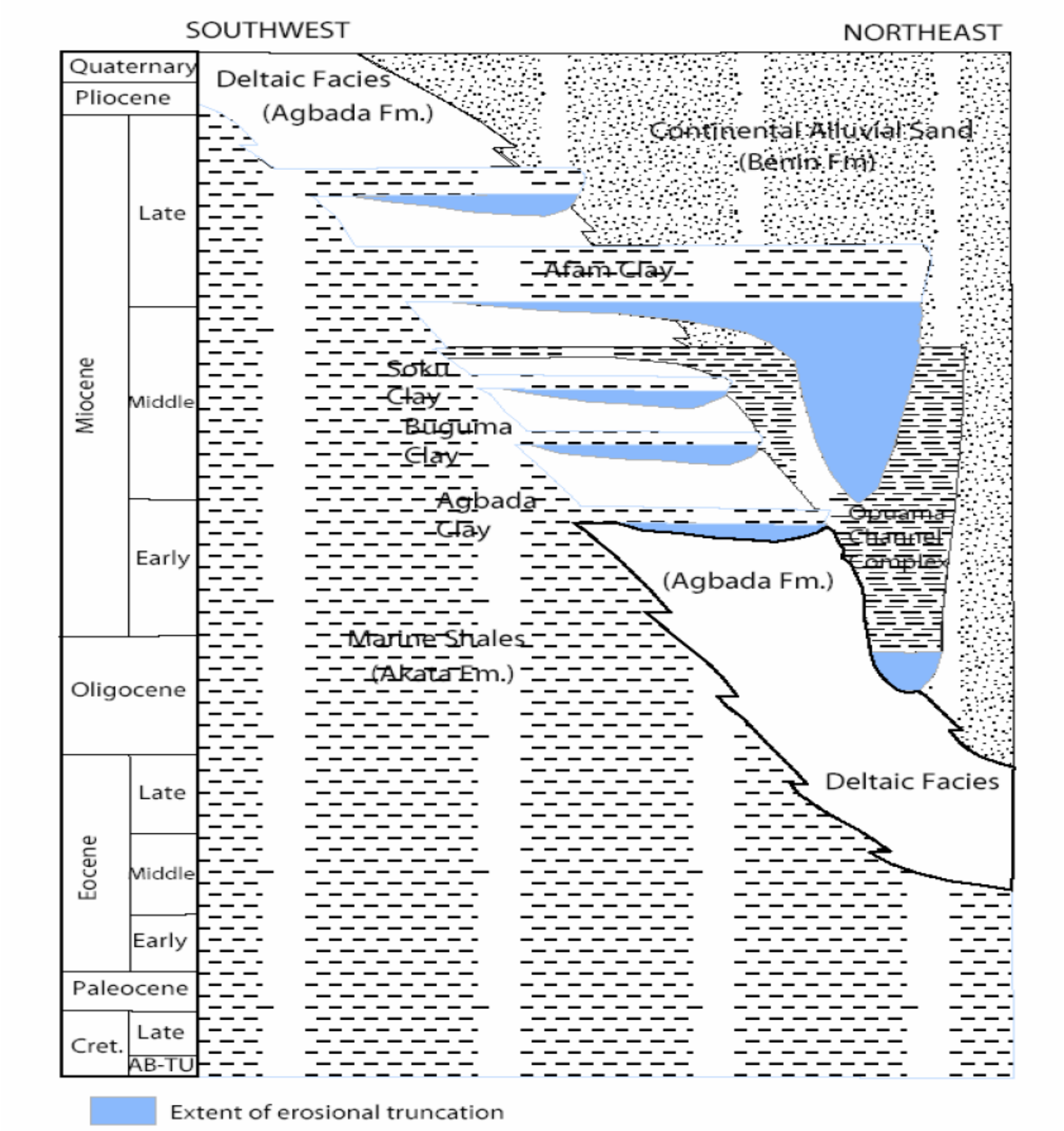
III. EVOLUTION OF THE NIGER DELTA FORMATION

The tectonic setting of the Niger delta (ND) is accepted to be the breaking of the African and South American Continental plates. This is followed by the accumulation of marine sediments in the Albian times with real Delta formation starting in the late Paleocene/Eocene at which sediments build out beyond troughs between basement horst blocks at the northern wing (flanks) of the present Delta. (Doust and Omatsola, 1989). It has since prograded into the Atlantic oceanic rust in a south westerly manner.

It is proposed that the Anambra –Benue rift valley forms the failed arm of the triple junction. In the direction of the Delta progradation are pre-terrestrial structures/frameworks. With the filling of this pre-tertiary depression, the depositional centre moves towards the sea. Further progradation of the Delta seawards leads to the failure of the oceanic crust under the increased load of sediments.

IV. NIGER DELTA STRATIGRAPHY:

As a result of deep wells drilled in the Niger Delta, (Short and Stauble, 1967) were able to identify three megafacies in the Niger Delta. The sedimentary environments so discovered are the top continental Benin formation, the middle transitional Agbada formation and the bottom marine Akata formation. The relative absence of hiatus in the progradation of the tertiary Niger Delta makes the identification of these lithological sequences easier. All three formations range from the Eocene to the recent age.



IV. METHODS OF PREDICTING ABNORMALLY-HIGH PORE PRESSURE

The portrayed techniques are isolated into two methods:
(1) Methods utilized before well construction, and
(2) Methods utilized amid and subsequent to well construction.

The main gathering incorporates: (a) systems for the forecast of unusually high pressure utilizing geographical and geophysical information as a part of locales with non-equilibrium compaction;
(b) Methods for the forecast of strangely high pressures in locales with inspire and disintegration, or subsidence, of compacted sedimentary rocks;
(c) Methods for the forecast of low pressure in areas with permafrost; and
(d) Methods of seismic investigation.

The techniques having a place with the second gathering fundamentally include the utilization of well-logging and drilling information:
(a) The technique for equivalent depth method;
(b) The technique for normal compaction trend;

(c) The system for compressional waves, and
(d) A system in light of the examination of the convergence of the radioactive isotope in shales.

A large portion of the weight recognition strategies portrayed depend on the perception that numerous overpressure rocks are connected with under compacted shale. The more prominent the undercompaction, the higher the porosity, and the more noteworthy the liquid weight. Undercompaction and decompaction are the two courses for the formation of higher porosity in correlation with an ordinary compaction pattern. The recent is imperative for the estimation of anomalous pressure.

V. MATERIALS AND METHODS

All the pore pressure expectation strategies depend on the reason that pore pressure impacts compaction subordinate shale properties, for example, porosity, density, sonic velocity and resistivity. Of all the different conceivable strategies, the compelling stress strategy has remained the most favored standard use. Consequently most pore weight expectations depend on Terzaghi (1943) which communicates the relationship between the overburden stress S, pore pressure P and the compelling $\boldsymbol{\sigma}$.

Terzaghi's connection reached out to strong rocks can be composed as:

$P = S - \boldsymbol{\sigma}$

The overburden stress is the pressure because of the consolidated pressure of the formation network and the liquids in the pore space overlying the arrangement of formation at a given depth. The overburden stress at any depth lithostatic inclination and the viable stress can be acquired from the reaction to changes in the shale porosity. In a typically compacted shale, the effective stress increases as the porosity diminishes. In this way by characterizing an ordinary compaction pattern (NCT) inside of the shale between the porosity expected if the thick shale grouping is typically forced and compacted, and the deliberate porosity from the well at the depth of interest. Pore pressure forecasts utilizing the development of the NCT. The supposition is that in the shallow area, the sediments are regularly compacted and pressured. Therefore the data from the shallow section can be used to create the NCT and extrapolated to depth using geologically reasonable values. A departure from the normal compaction curve, having porosities higher than indicated by NCT at the same depth is the beginning of overpressure.

VI. METHODOLOGIES STUDIED

There are number of methods which are available for the pore pressure prediction over a single well or even in the case of seismic data. But we are focusing on only those methods which are currently running or the methods used in oil industry for the pore pressure prediction. We use the methods like Eaton’s Resistivity, Bower’s Sonic for the pore pressure gradient analysis and also using Eaton’s approach for the Fracture gradient analysis. All the methods are listed below.

VII. EATON’S APPROACH

The Eaton Method is one of the more widely used quantitative methods. This method applies a regionally defined exponent to an empirical formula. His study has resulted in the development of four equations that may be used for the prediction of geopressure from well logs and drilling data. Equations are given for use with resistivity plots, conductivity plots, sonic travel-time plots, and corrected "d" exponent plots. All equations have the same theoretical basis. In 1965, Hottman and Johnson presented a method for predicting geopressure by using resistivity and sonic log data. This technique has received wide acceptance even though the prediction charts were based only on data concerning Tertiary age sediments in the Gulf Coast area. It was specifically pointed out that these techniques were applicable only in areas where the generation of geopressures is primarily the result of compaction due to overburden stress. In 1972, this author presented a theory on the effect of overburden stress gradients and geopressure prediction techniques. Compaction caused by overburden stress was described classically in a soil mechanics book by Terzaghi and Peck in 1948. With a vessel containing a spring and a fluid, they simulated the compaction of clay that contained water. Eaton uses the following formula for the calculation of pore pressure gradient through resistivity.

$$\mathbf{PP = OBG - (OBG - PPN)\,(Ro//\,RN)^{x}}$$

Where PP = Pore Pressure Gradient (ppg), OBG = Overburden Gradient (ppg), PPN = Normal Pore pressure Gradient (ppg), Ro = Observed Resistivity (ohms-m), R_N = Normal Resistivity (ohms-m), x = Eaton Exponent (dimensionless), which is 1.2 – 1.5.

VIII. BOWER’S APPROACH

Bower’s method uses the sonic velocity and empirically determined parameters to determine the vertical effective stress, which is then subtracted from the overburden (the vertical total stress) to determine the pore pressure. This method can be applied to predict pore pressures caused either by compaction disequilibrium or due to some source mechanism. Only two empirical parameters are required when excess pressures are caused by compaction disequilibrium. The value of the two empirically determined parameters can be determined in a Compaction Trend Analysis or chosen by experience in offset wells. We need to know the value of the sediment's previous maximum effective stress, σmax, to perform this analysis plus we need to establish the sediment's “unloading” velocity effective stress behavior, which is specified by the unloading parameter, U. The value of σmax is calculated from the normal compaction response and the user- specified value of σmax; and the value of U is empirically determined. Pore Pressure are calculated as follows

$$PP = OBG - \frac{(\sigma_{max})^{(1-U)} \left(\frac{\frac{10^6}{DT} - \frac{10^6}{DT_{ml}}}{A} \right)^{(U/B)}}{depth} \quad \text{and}$$

$$\sigma_{max} = \left(\frac{\frac{10^6}{DT_{min}} - \frac{10^6}{DT_{ml}}}{A} \right)^{(1/B)}$$

Where PP = Pore Pressure Gradient (ppg), OBG = Overburden Gradient (ppg), DT = Sonic travel time (microsec/m), DTml = Sonic travel time corresponding to Vmax, A, B, U = Empirical values, Vmax = The velocity at which unloading occurred for sediments buried at depths greater than dmaxv, dmaxv = Depth at which unloading has occurred, depth = TVD in appropriate units.

IX. 3-D SEISMIC DATA APPROACH

The interval velocity analysis normally used for the pore pressure analysis, is used throughout in all the Niger Delta fields in the form of interval velocity that got extracted from the 3-D for corresponding fields of interest. The basic sequence of pore pressure analysis for 3-D case was applied and 3-D analysis was used for the calibration of wells. 2-D section has been also generated for better visualization of pore pressure variation within a particular depth interval. The beauty of 3-D velocity cube is that in whole velocity cube pore pressure can be predicted at any point and to the last extent of the data also its lateral resolution will be high. On the other hand in the case of well logs predictions of the variation of pore pressure at a point very accurately but predicting at some other point away from the well would not be accurate as much as in the case of seismic, the value will be the interpolation between wells, its lateral resolution would be less and also it has depth limitation (up to log depth).

X. PORE PRESSURE PREDICTION FROM DRILLING DATA

Based on literature review done, it is basically clear that there are models of assessing pore pressure prediction on Niger Delta brown fields.

This methodology is to identify overpressure generation mechanisms in the Niger Delta brown fields by using d-exponent versus effective stress plotting, and discuss implications for pre-drill prediction, also review approaches to allow for these mechanisms. This model mechanism (F. Nweke and A. Dosunmu’s method) examine on available data of Niger Delta brown fields to determine pore pressures. The calculated pore pressure data compared with the available pore pressure data of these brown fields, to assess the validation of this new approach / model in Niger Delta brown fields.

In this research work, emphasis will be placed in exploring pore pressure prediction models, in order to predict and analyze as an approach to high pressure wells. This pore pressure prediction model is new and propelled methodology of pore pressure prediction from well drilling parameters and logs. The verified and recommended model objective is to improve the drilling performance for Niger Delta brown fields.

The workflow implemented to analyze and ultimately choose the best pore pressure prediction strategy is outlined below. This workflow was performed for a lot of offset wells in Niger Delta region.

1. Identify, acquire and review offset wells data in Niger Delta brown including;

- Petrophysical and seismic data.

- Drilling records.

- Measured pressure data.

2. Construct pore pressure prediction model using d-exponent model.

3. Include offset well data in the pore pressure prediction model and modify Eaton d-exponent model.

4. Align pore pressure prediction model, if vital.

5. Examine pore pressure prediction model against information acquired from looking into drilling records and select or build up a close exact pore pressure prediction model for planning HP wells in Niger Delta brown fields.

6. Modify Eaton's model which consisted of calculating the ratio between effective stress and the d-exponent at each well, in order to find a robust calculated normal compaction trend using regression best fit line for the entire field.

F. NWEKE AND A. DOSUNMU APPROACH (NEW MODEL THEORY)

Pore pressure prediction model is defined in order to accomplish the unique objective of this study that is to conduct pore pressure prediction in Niger Delta brown fields. The study aims to optimize existing drilling data to evaluate d-exponent and effective stress. Prediction is to be Niger Delta brown fields specific.

Multiple linear regression technique is used for the methodology of pore pressure prediction which is analytical approach that uses multiple independent variables to predict a dependent variable. The pore pressure prediction model adapted for this study is a function of independent variables. Examples of the independent variables are drilling parameters like; bit diameter, weight on bit, rotary speed, penetration rate, mud weight, overburden pressure gradient and compaction effect while the dependent variables are d-exponent, effective stress, and pore pressure gradient which is the main aim of the this new analytical approach (F. Nweke and A. Dosunmu method).

All the drilling parameters were collected from Niger Delta brown oil fields operator data base and then piped to a central computer for storage and synthesis. The noisy data is going have a negative effect on the outcome of the process, for this reason the data to be piped as much noise free as possible. The methodology is to handle several Niger Delta brown fields' data, and concentrate all the data in a unique data set and running the statistical analysis. It is considered that the methodology is going to function even if the mud type, the drilling depths, and bit types are different, because all such parameters are taken into account within the model itself.

Because the predictive model is field specific; for two wells data of which is being collected simultaneously the data process should be performed considering the data of two or more wells mutually for the sections across which the formation properties are the same. In case the lithology of the two or more wells are totally different from each other the process should be run individually for each well.

The D exponent philosophy was produced with the objective of normalizing the penetration rate from drilling parameters. The regular scientific methodology utilized as a part of cutting edge weight assessment projects is to uproot the impacts of such variables as rock sort and bit condition from penetration rate so that abnormal penetrating reactions can be perceived and likened to pore pressure. This might be considered as normalizing ROP to measure overpressure in much the same way that cuttings gas is standardized to evaluate the size of an show. Through usage, the mathematical variable obtained following such normalization, or modeling, generally is referred to as the "*d*-exponent" (d, d_{exp}). The d-exponent was initially applied by Bingham (1965) to the exact meaning of the relationship between rock strength, work done by the drill bit, and ROP. This can be communicated in the general form:

$$\frac{R}{N} = K \times \left(\frac{W}{D}\right)^{d}$$

Where:

R = penetration rate, ft/min

N = rotary speed, rpm

W = weight on bit, lb

D = diameter of bit, ft

K = matrix strength constant, dimensionless

d = bit weight exponent, dimensionless

Drillability of rock at the bottom of the borehole is related to two factors, (1) rock strength and (2) confining stress supplied by drilling mud density — the overbalance. Jordan and Shirley (1966) approximated an answer for Bingham's comparison for a single unknown, the d-exponent, by wiping out variable K (accepting it to be steady as in a uniform shale). They also inserted constants in the equation to in-corporate American oilfield units of measurement.

$$d = \frac{\mathrm{Log}\left(R/60N\right)}{\mathrm{Log}\left(12W/10^{6}D\right)}$$

Where:

R = penetration rate, ft/hr.

N = rotary speed, rpm.

W = weight on bit, lb.

D = diameter of bit, inches.

Different alterations or varieties have been made by individual logging organizations to the d-exponent for particular employments. In a uniform lithology, with steady piece sort and mud overbalance, the d-example will increment with expanding profundity — that is, with expanding compaction or rock quality. By and large, it will have a backwards connection with ROP.

The geologic setting of the Niger Delta fields is obviously different from the geology of the Gulf of Mexico. The sedimentary sequence in the Niger Delta, for example, includes alternations between sand and shale deposited in shallow marine environments. In addition, the Niger Delta foothills are being subjected to lateral stresses of large magnitude, where the maximum horizontal stress is several times larger than the vertical stress (Torres, 2001; Uribe & Solano, 2006).

An advantage of this F. Nweke and A. Dosunmu’s method is that the results can be obtained in real time, as drilling parameters are collected through sensors. Whatever other data got by the Mud Logging Unit can likewise be utilized to identify development pressure changes. For instance, changes in penetrating liquid, for example, all out gas content, temperature, thickness, saltiness, and so on or changes in qualities of the development tests accumulated in the shale shaker, for example, density, shape and sum, might identify with zones of overpressure (Moutchet and Mitchell, 1989). The procedure used for estimation of the pore pressure profile from the D exponent is based on Eaton's multiple linear regression -Equation below, (Eaton, 1972), using the adjustment parameter F^{a} determined from the D Exponent. Eaton's multiple linear regression is defined by:

$$\frac{p}{z} = \frac{s}{z} - \left[\frac{s}{z} - \frac{p_n}{z}\right] * f^{\alpha}$$

Where the dependent variable p is pore pressure, and the independent variables: z is depth, P_n is normal pressure, p/z is the pore pressure gradient (psi/ft), s/z is the overburden pressure gradient (psi/ft), $\mathbf{P}_n/Z$ is the normal pore pressure gradient (psi/ft), and f^a or $(D/Dn)^b$ is the adjustment parameter.

The adjustment correlation parameter f^a or $(D/Dn)^b$, depends on the type of data available, which may be either seismic, sonic, resistivity, or conductivity logs, drilling parameters, etc. According to the above statement, the following equation is a function of drilling parameters only:

$$\frac{p}{z} = \frac{s}{z} - \left[\frac{s}{z} - \frac{p_n}{z}\right] * \left[\frac{D}{D_n}\right]^b$$

Where: *D* is the *D* exponent, and D_n is the normal trend of the *D* exponent (Normal Compaction Trend, NCT). Eaton (1972), using this methodology in the Gulf coast proposed that the exponent b in equation above varies between 1.2-1.5. This exponent relies on upon the territorial geologic setting, since it includes the overburden and pressure gradient.

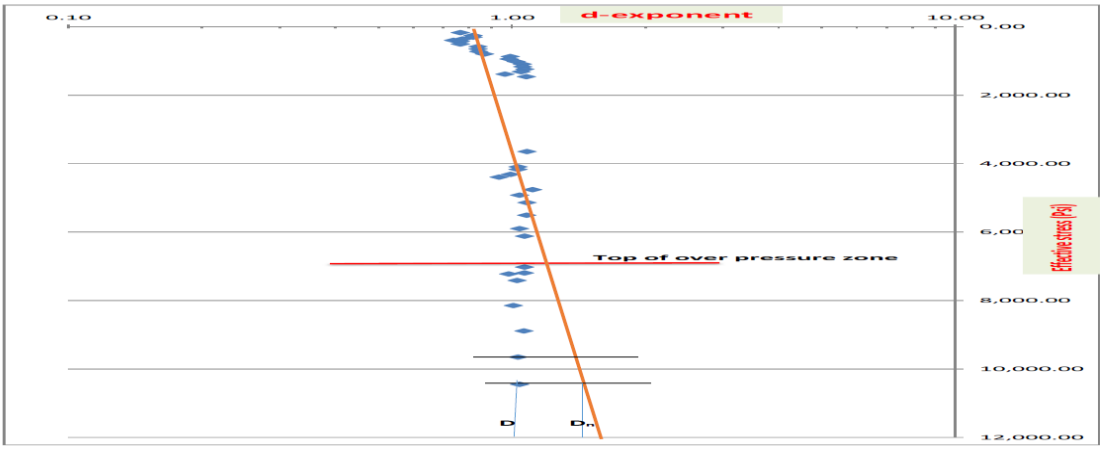
The procedure for pore pressure forecast known as D exponent is an element of a type of change that was initially characterized for the Gulf of Mexico (Jorden and Shirley, 1966; Eaton, 1972). A constraining element of this procedure is the meaning of the Normal Compaction Trend (NCT), which should be translated from the information (Mouchet and Mitchell, 1989).In this study, the D exponent methodology was modified to make it applicable to the Niger Delta Formation in various oil field in Nigeria.

The F. Nweke and A. Dosunmu's approach consisted of calculating the ratio between effective stress and the D exponent at each well, in order to find a robust NCT for the entire field, thus reducing subjectivity in the traditional D exponent methodology, using this methodology in the Niger Delta brown fields proposed that the exponent b in above equation is 0.6 to 1, using common approximation method. Pore pressure determinations from Measured Direct Tests (MDT) at different wells in Niger Delta brown fields affirmed the prescient capacity of this methodology.

The new approach methodology provides at least three main operating advantages (F. Nweke and A. Dosunmu's approach):

1. It is a low cost methodology and thus has a minor financial impact on exploration and production.
2. This new method method can be performed in real time during drilling.
3. Implementation and application is simple, and does not require highly skilled personnel.

As it was mentioned earlier, however, the fundamental goal of this study was to derive a less subjective analytical approach to calculating the pore pressure starting from the methodology of the D exponent, applied to all Niger Delta brown field formation. This approach was devised because in normally pressured sediments, D exponent is expected to increase with depth. In addition, effective stress is expected to increase with depth in normally compacted sediments. Therefore, deviations from a trend line in a plot of D exponent versus effective stress should be related to deviations from normal pore pressure, as shown in figure below:



XI. CONCLUSION

The following are the conclusions reached in this research work:-

1. By using the ratio between D exponent and effective stress (modified Eaton d-exponent model), pore pressure can be estimated more accurately than the standard D exponent method for Niger Delta brown fields. This approach is more objective for definition of the normal compaction trend with a power law function of $\boldsymbol{\sigma} = 2952\ Dn^{1.65}$, and because the NCT is defined for the entire field rather than for individual wells. The exponent of adjustment that was originally defined for most areas of the world which is a range of 1.2 to 1.5, while in the case of Niger Delta brown fields, an objective exponent of adjustment was derived ranging from 0.6 to 1.

2. Abnormally pressured sections of the Agbada Formation were easily identified using the using Eaton's, Bowers and F.Nweke & A. Dosunmu's method.

3. This study confirmed that the standard D exponent methodology(Eaton's method) as well as the proposed new approach (F. Nweke and A. Dosunmu's method) provides reasonable pore pressure determinations before and during drilling operations.

BIOGRAPHY:

1. Nweke, I. Francis, had a first degree in Petroleum Engineering from Federal University of Technology, Owerri, Imo State, Nigeria. He obtained his master's degree in Gas Engineering from University of Port Harcourt, Rivers state, Nigeria and currently a Ph D student in the same University of Port Harcourt, where he is carrying out research on pore pressure prediction in planning HPHT wells.
He is currently working as a Senior Drilling Engineer in Nigerian Agip Oil Company (Eni International) with 12 years working experience in Drilling and Completion Engineering.
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Registered member - Council for the Regulation of Engineering in Nigeria - (COREN). Membership number: R. 15,511.

2. Adewale Dosunmu is a Professor of Petroleum Engineering in the Department of Petroleum & Gas Engineering, University of Port Harcourt, Nigeria, and the Shell Aret Adams Chair in Petroleum Engineering at the University of Port Harcourt, Nigeria. He is also a consultant to several E&P companies in Nigeria and overseas. He is a recognized international expert in well engineering in the special area of wellbore stability. Prof. A. Dosunmu has previously served as an SPE Distinguished Lecturer. He is a member of several professional societies, including the Society of Petroleum Engineers (SPE) and the Nigerian Society of Engineers, and is a professional registered engineer. He has been on accreditation teams at many universities and is a visiting professor to several universities offering courses in petroleum engineering.

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